

The bobbin 310 prevents the first portion of the FPC 400 from sliding along the rotation axis by means of the winding guides 311 and 312. When the bobbin 310 is made of resin, rubber or the like, the FPC 400 can avoid damage caused by contacting with a metal member of the hinge unit 300a. With rotation of the bobbin 310 (or the upper unit 200), the first portion of the FPC 400 is tightened or loosened. The first portion of the FPC 400 is apart from other parts of the folding mobile phone 10 except the bobbin 310 even if the bobbin 310 rotates.

The FPC holding member 320 has a T shaped form corresponding to a combination of the rotating axis and the folding/unfolding axis. The FPC holding member 320 comprises a holding plate 321 and guide arms 322 and 323 extending from side ends of the holding plate 321 along the folding/unfolding shaft 305. The guide arms 322 and 323 provide guide plates 324 and 325 perpendicular to the guide arms 322 and 323. The guide plates 324 and 325 have C shaped form and freely engage the folding/unfolding shaft 305 at outer sides of the folding/unfolding resistance generating portions 308a or 308b to support the FPC holding member 320.

The holding plate 321 provides an upper hook 326 and a pair of lower hooks 327 and 328 to guide the third portion of the FPC 400 and to fix the FPC fixing member 340. At lower edge of the holding plate 321, a guide plate 329 is provided. The guide plate 329 has a pair of side hooks 330 and 331 to guide the third portion of the FPC 400 and to fix the FPC fixing member 340.

The fixing member 340 includes a pressing plate 341 opposed to the holding plate 321 of the FPC holding member 320 to sandwich a corresponding part of the FPC 400 between them. The fixing member 340 provides clips 342 and 343 at both sides thereof to clip or grip outer cases of the folding/unfolding resistance generating portion 308a and 308b. At lower edge of the pressing plate 341, another pressing plate 344 is provided to be opposed to the guide plate 329 and to sandwich a corresponding part of the FPC 400 between them.

Turning to FIG. 5, the fixing member 340 is fixed to the FPC holding member 320 by the means of hooks 326-328, 330 and 331. The guide plates 324 and 325 receive the folding/unfolding shaft 305 while the clips 342 and 343 clip the folding/unfolding resistance generating portions 308a and 308b over the holding plate 321, thereby the combination of the fixing member 340 and the FPC holding member 320 is attached to the hinge unit 300a.

The bobbin 310 serves as a rotative direction wound portion 350 which is wound with the first portion of the FPC 400 and which is rotatable in the rotative direction D2. That is, the central axis of the bobbin 310 substantially coincides with the rotative axis. The guide plate 324, the flange portion of the L shaped bracket 307a and an end portion of the folding/unfolding shaft 305 serves as a left-hand folding/unfolding direction wound portion 351 which is wound with a fourth portion of the FPC 400 like the second portion of the FPC 400. Similarly, the guide plate 325, the flange portion of the L shaped bracket 307b and the other end portion of the folding/unfolding shaft 305 serves as a right-hand folding/unfolding direction wound portion 352 which is wound with the second portion of the FPC 400. The guide plates 324, 325 and the L shaped brackets 307a and 307b serve as winding guides like the winding guides 311 and 312. The central axis of the folding/unfolding shaft 305 substantially coincides with the folding/unfolding axis.

The rotative direction wound portion 350 of the bobbin 310 prevents the first portion of the FPC 400 from sliding

along the rotation axis, thereby the FPC 400 can avoid being rubbed and/or bent by contact with the metal member of the hinge unit 300a. If the upper unit 200 rotates in relation to the lower unit 100, then the first portion of the FPC 400 merely receives small stress since it is tightened or loosened.

The FPC holding member 320 prevents the third portion of the FPC 400 from coming into contact with a moving part of the hinge unit 300a by means of the holding plate 321 and guide arms 322 and 323. In other words, the FPC holding member 320 keeps the third portion of the FPC 400 from coming in contact with the moving part of said hinge unit. Each of the folding/unfolding direction wound portions 351 and 352 prevents the second (or the fourth) portion of the FPC 400 from sliding along the folding/unfolding axis, thereby the second (or the fourth) portion of the FPC 400 can avoid being rubbed and/or bent by contact with the metal member of the hinge unit 300a. If the upper unit 200 and the lower unit 100 are unfolded, then the second (and/or the fourth) portion of the FPC 400 merely receive small stress since it is tightened or loosened.

Thus, the hinge mechanism prevents signal lines of the FPC 400 from being cut by rubbing with the hinge unit 300a. Furthermore, the hinge mechanism can lengthen a lifetime of the FPC 400.

The folding/unfolding shaft 305 may have thinner parts which are thinner than the other part thereof and used for the folding/unfolding direction wound portions 351 and 352. Use of the thinner shaft can make a winding diameter of the second (or four the) portion of the FPC 400 smaller and implement a small and thin design of the folding mobile phone 10.

The hinge structure can hold and fix a plurality of FPCs in a small way. Accordingly, when the many signal lines are necessary between the lower unit 100 and the upper unit 200, the signal lines can be divided in two or more groups for plural FPCs. The FPCs have shape as illustrated in FIGS. 7A-7D.

FIGS. 7A and 7B are plane views showing a spread state of first and second examples of the FPC having the second portion wound around the right-hand folding/unfolding direction wound portion 352. FIGS. 7C and 7D are plane views showing a spread state of first and second examples of the FPC having the forth portion, instead of the second portion, wound around the left-hand folding/unfolding direction wound portion 351.

In FIG. 7A, the FPC 400R.1 has a first connector 401 to be connected to a circuit board provided in the lower unit 100. A rotative axis winding part 402 (corresponding to the first part mentioned above) is for being wound around the rotative direction wound portion 350. A fixing part 403 (corresponding to the third part mentioned above) is for being fixed by the FPC holding member 320 and the FPC fixing member 340. A folding/unfolding axis winding part 404 (corresponding to the second part mentioned above) is for being wound around the right-hand folding/unfolding direction wound portion 350. A second connector 407 is for connecting with a circuit board provided in the upper unit 200.

The fixing part 403 includes a vertical part 403a to be extended from the bobbin 310 and sandwiched between the guide plate 329 and the pressing plate 344, and a horizontal part 403b to be sandwiched between the holding plate 321 and the pressing plate 341 and extended to the right-hand folding/unfolding direction wound portion 352 along the guide arm 323.

The length of the rotating axis winding part 402 is decided according to the number of turns and a diameter of the